Form ESA-B4. Summary Report for ESA-113-3
Public Report - Final

Company	DuPont	**ESA Dates**	6/17/2008 - 6/19/2008
Plant	Ft. Madison, Iowa	**ESA Type**	Compressed Air
Product	Polymers and inks	**ESA Specialist**	Kelly Kissock

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction:

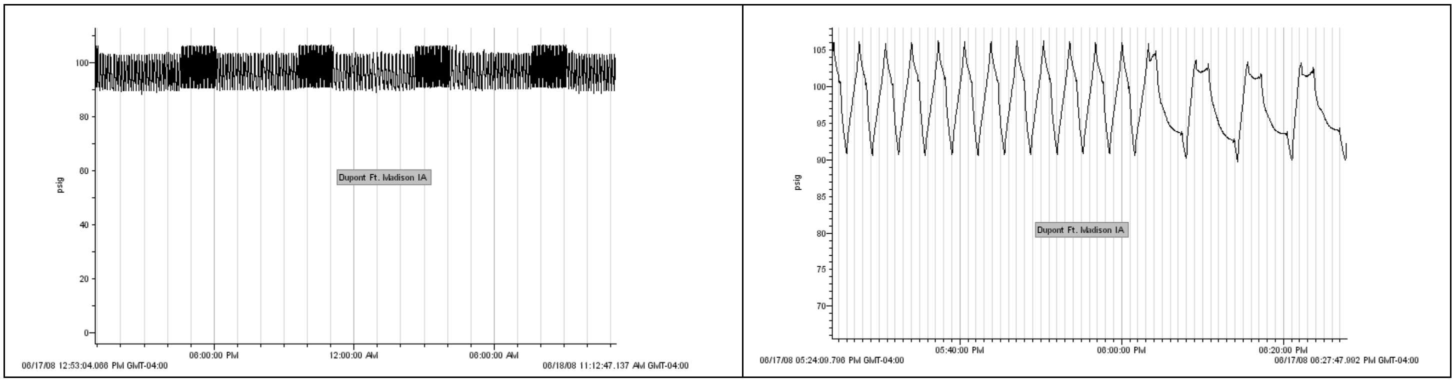
The plant produces polymers and inks. In 2007 average electrical cost was $0.057 per kWh. In 2007 average natural gas cost was about $7.23 /mcf.

The plant has two compressed air systems; process air and breathing air. Process air is used as feedstock for the nitrogen plant, to purge electrical panels, power air motors and air pumps, raise pneumatic cylinders and for other general purposes. Breathing air is used to provide positive pressure inside helmets when loading and unloading hazardous chemicals.

Process compressed air is supplied by two Atlas Copco 250-hp air-cooled oil-free rotary-screw air compressors operating in parallel. One compressor runs in modulation mode as the lead compressor and the other runs in load/unload mode as the lag compressor. The lag compressor operates in auto-shutoff mode, when running unloaded for about 10 minutes. The compressors operate 8,760 hours per year to supply air for the fire system, panel purge system and other continuous processes. Compressed air is dried to a dew-point temperature between -1 F and -100 F by a single desiccant dryer. The dryer desiccant is regenerated by room air supplied by an independent 15-hp blower and heated using electric resistance heating. The regeneration cycles vary automatically with the load. The compressed air fills two 1,040 gallon storage tanks configured in parallel. An automatic pressure reduction valve maintains the pressure of compressed air to the general plant at about 95 psig, while a second automatic pressure reduction valve maintains the pressure of compressed air to the nitrogen plant at about 85 psig. A gauge on the HSD secondary storage tank in the far part of the plant indicated a pressure of 95 psig; thus pressure drop through the distribution system is minimal.

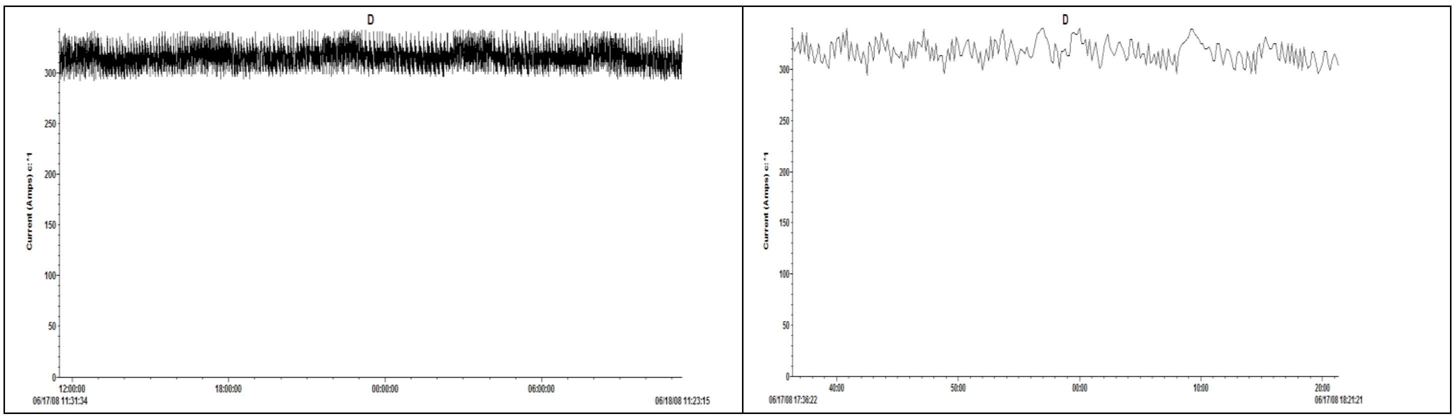
Breathing air is supplied by a single Atlas Copco 150-hp air-cooled oil-free variable-speed rotary-screw air compressor. The compressor operates 8,760 hours per year.

Portable data loggers logged process header air pressure and current draw for AC-1, AC-2 and the Breathing Air compressor for about 24 hours from about noon on 6/17/2008 to noon on 6/18/2008. The data are shown in the graphs below. The left graph shows data for the entire 24 hour period. These data indicate regular 1.5 hour periods of high compressed air demand that occur every 5 hours. The right graph shows a close up of the data from 5:30 pm to 6:30 pm on 6/17/2008 that includes both the high and normal demand periods. The high demand periods are caused by the intermittent operation of the nitrogen plant, which uses compressed air as a feed stock to separate out the nitrogen and oxygen and store the gasses in tanks.



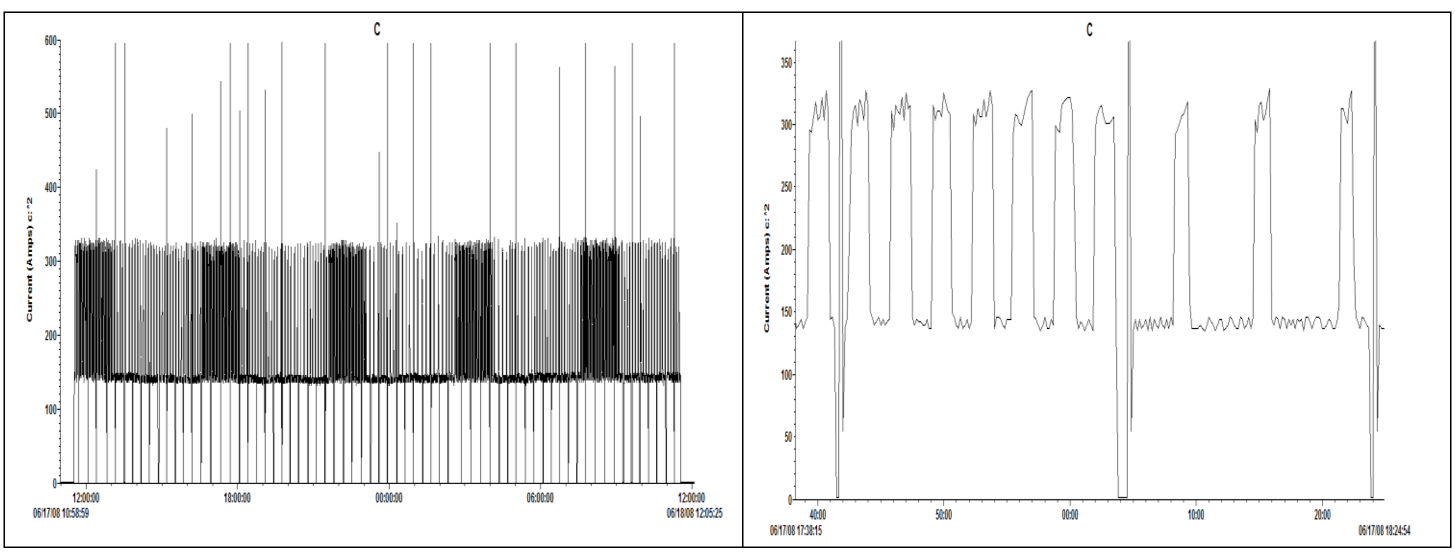
Header air pressure from about noon on 6/17/2008 to noon on 6/18/2008, and from 5:30 pm to 6:30 pm on 6/17/2008.

The current draw data from AC-1 indicate that the lead compressor is operating in modulation mode. Average current draw is about 316 Amps, average power input is about 237 kW and average power output is about 284 hp, indicating the compressor is fully loaded over the entire interval. Assuming a 10-hp cooling fan and 4 scfm/hp, average compressed air output is about 1,100 scfm.



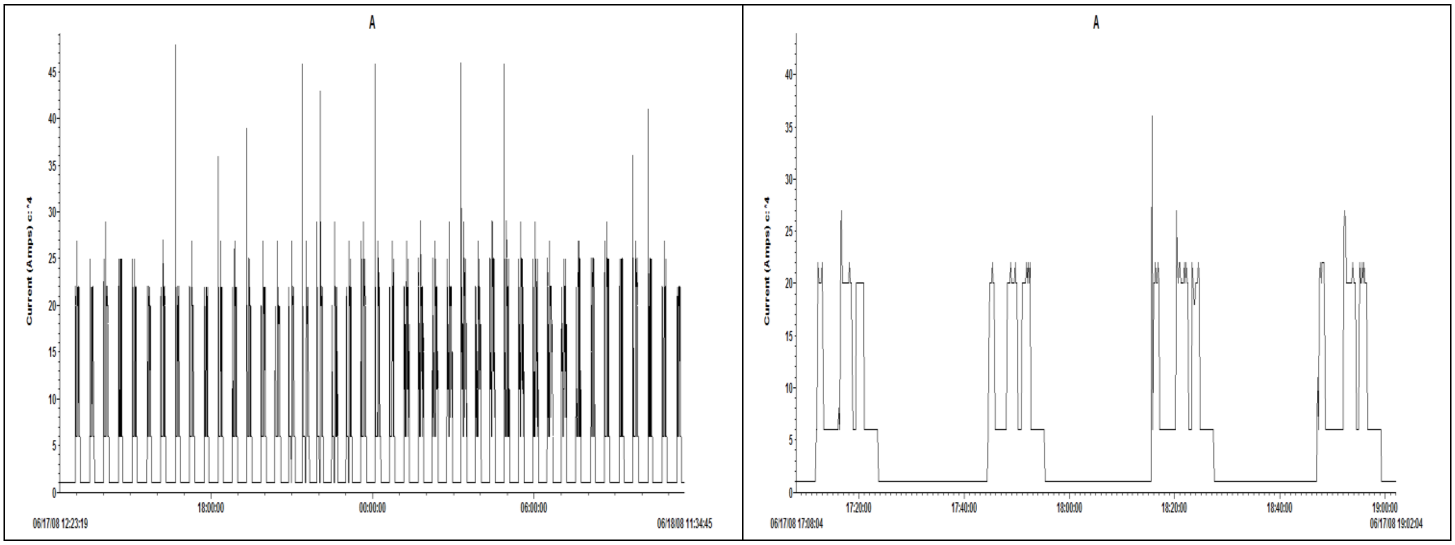
AC-1 current draw from about noon on 6/17/2008 to noon on 6/18/2008, and from 5:30 pm to 6:30 pm on 6/17/2008.

The current draw data from AC-2 indicate that the lag compressor is operating in load/unload mode. It draws about 310 Amps when loaded and about 140 Amps when unloaded; thus the fraction power at no load is about 45%. It is loaded and producing compressed air about 50% of the time during periods of high demand, and about 25% of the time during periods of normal demand. Average current draw is about 182 Amps, average power input is about 136 kW and average power output is about 163 hp. The average fraction of net compressor power is 0.56 and average fraction of peak output capacity is 0.20. Assuming a 10-hp cooling fan and 4 scfm/hp, average compressed air output is about 220 scfm.



AC-2 current draw from about noon on 6/17/2008 to noon on 6/18/2008, and from 5:30 pm to 6:30 pm on 6/17/2008.

The current draw data from the breathing air compressor show that the VSD compressor is minimally loaded and shuts down over periods of no-load.



Breathing air current draw from about noon on 6/17/2008 to noon on 6/18/2008, and from 5:30 pm to 6:30 pm on 6/17/2008.

Based on these data, we estimate that total air compressor electricity use is about 3,305,450 kWh/year, which costs about $188,411 per year.

	AC-1	AC-2	BA	Totals
Average Current (Amps)	182.0	316.4	5.9	
Voltage (V)	480	480	480	
Power Factor (kW/kVA)	0.9	0.9	0.9	
Average Power (kW)	136.2	236.7	4.4	
Hours per year	8,760	8,760	8,760	
Total Energy (kWh/yr)	1,192,762	2,073,830	38,858	3,305,450
Unit Cost ($/kWh)	0.057	0.057	0.057	
Unit CO2 (lb CO2/kWh)	2	2	2	
Total Cost ($/yr)	67,987	118,208	2,215	188,411

Objective of ESA:
The objective of this energy saving assessment (ESA) was to assist plant personnel in reducing compressed air operating costs by:

- Training plant personnel in compressed air system energy efficiency fundamentals
- Training plant personnel in the use of Air Master+
- Assisting plant personnel in identifying and quantifying energy saving opportunities.

Focus of Assessment:
The ESA focused on evaluating compressed air end uses, distribution system and plant for energy efficiency opportunities.

Approach for ESA:
The approach for this assessment was to:

- Discuss DOE and company objectives for the assessment.

- Inspect compressed air end uses, distribution and plant.
- Discuss energy saving opportunities for compressed air systems.
- Identify energy saving opportunities in the plant.
- Demonstrate the use of Air Master+.
- Develop an Air Master+ model of the compressed air system at the plant
- Quantify savings opportunities.
- Share and discuss savings opportunities.

General Observations of Potential Opportunities:
We identified the following assessment recommendations (ARs).

AR-1: Install Additional Compressed Air Storage Capacity and Reduce Cut-out Pressure
The lag compressor loads at about 96 psig and unloads at about 120 psig, with an operating band of about 24 psig. The normal operating band is about 10 psig. The unusually large operating band is probably to reduce cycling. Currently, the each compressor load/unload cycle lasts about 3 minutes during periods of peak demand. We recommend install an additional 1,024 gallon compressed air storage tank and changing the operating pressure band to 96 psig to 106 psig. This would reduce average compressed air pressure by about 7 psig and reduce lag compressor power use by about 3.5%. We estimate that these actions would save about 41,747 kWh/year and $2,380 /year. This is a medium-term opportunity.

AR-2: Install Pressure Booster For HSD and Reduce Plant Pressure to 85 psig
Compressed air pressure to the plant is maintained at about 95 psig. According to personnel, the plant had previously operated with 85 psig air, but the pressure was raised to accommodate the HSD process. We recommend installing an small pressure booster for the HSD system and reducing the operating pressures of both the lead and lag compressors by about 10 psig. This would reduce average compressor power use by about 5%. We estimate that these actions would save about 163,330 kWh/year and $9,310 /year. This is a medium-term opportunity.

AR-3: Institute Program to Indentify and 'Fix Compressed Air Leaks
We identified numerous leaks with an ultrasonic sensor. Typically, leak loads in most plants are about 25% of total compressed air output. We estimate that instituting a program to identify and fix compressed air leaks could reduce the leak load by about 200 scfm. We estimate that this would save about 228,057 kWh/year and $12,999 /year. This is a near-term opportunity.

AR-4: Consider Installing Blowers For Panel Purge Air
Flow meters on small electrical panels indicated that compressed air for purging was about 100 scf/hr or 1.7 scfm. If large panels use 5 times this amount of air, each large panel uses about 8.5 scfm of air, and the 50 or so panels in the plant use about 425 scfm of air. We estimate that installing blowers to supply purge air instead of using compressed air would save about 495,098 kWh/year and $28,221 /year. This is a medium-term opportunity.

AR-5: Consider Replacing Four M4 Air Pumps in 47 Process with Electric Pumps
According to 47 process personnel, four M4 air pumps will operate continuously in the future. Air pumps use about six times more electricity than electric pumps. Personnel report that electric pumps are available that have adequate reliability. Based on manufacturer literature, we estimate that each M4 pump uses about 20 scfm. If so, we estimate that replacing four M4 air pumps in 47 process with electric pumps would save about 69,636 kWh/year and $3,969 /year. This is a medium-term opportunity.

AR-6: Consider Replacing Nine 1-hp Air Motor Powered Agitators in Anatase Mixing with Electric Powered Agitators
According to personnel, about nine 1-hp air powered agitators operate continuously in the Anatase Mixing area. Air powered motors use about six times more electricity than electric motors. Based on conversation with the air-motor vendor, each 1-hp air motor uses about 25 scfm. If so, we estimate that replacing nine 1-hp air powered agitators with electric powered agitators would save about 204,558 kWh/year and $11,660 /year. This is a medium-term opportunity.

Total Savings:

We estimate that total savings from implementing these recommendations would be about 1,202,426 kWh/year and $68,539 per year. We estimate that near-term savings from implementing these recommendations would be about 228,057 kWh/year and $12,999 per year. We estimate that medium-term savings from implementing these recommendations would be about 974,369 kWh/year and $55,540 per year. This represents about 30% of total compressed air energy use.

Management Support and Comments:

Thorough, good things to think about, good measurements. Valued the expertise so that we could hit the ground running. Concrete examples and projects to work on for gains. Presented in positive manner. Appreciated educational components.

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